Amendments

In the Claims:

This listing of claims will replace all prior versions and listings of claims in the application.

Claims 1-219 (cancelled).

220. (new) A composition comprising:

(a) a non-natural molecular scaffold comprising:

(i) a core particle comprising a virus-like particle of an RNA bacteriophage; and

(ii) an organizer comprising at least one first attachment site,

wherein said organizer is connected to said core particle by at least one covalent bond; and

(b) an antigen or antigenic determinant with at least one second attachment site,

wherein said antigen or antigenic determinant is at least one self antigen, a peptide thereof, or fragment thereof;

wherein said second attachment site is capable of association through at least one non-peptide bond to said first attachment site; and

wherein said antigen or antigenic determinant and said scaffold interact through said association to form an ordered and repetitive antigen array.

221. (new) The composition of claim 220, wherein said RNA bacteriophage is selected from the group consisting of:

(a) bacteriophage Qβ;

(b) bacteriophage R17;

(c) bacteriophage fr;

(d) bacteriophage GA;

(e) bacteriophage SP;

(f) bacteriophage MS2;

(g) bacteriophage M11;

(h) bacteriophage MX1;

(i) bacteriophage NL95;

(k) bacteriophage f2; and

(l) bacteriophage PP7.

222. (new) The composition of claim 220, wherein said bacteriophage is bacteriophage Qβ.

223. (new) The composition of claim 220, wherein said bacteriophage is bacteriophage fr.

224. (new) The composition of claim 220, wherein said bacteriophage is bacteriophage GA.

225. (new) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises recombinant proteins, or fragments thereof, of an RNA bacteriophage.

226. (new) The composition of claim 225, wherein said bacteriophage is bacteriophage Qβ.

227. (new) The composition of claim 225, wherein said bacteriophage is bacteriophage fr.

228. (new) The composition of claim 225, wherein said bacteriophage is bacteriophage GA.

229. (new) The composition of claim 225, wherein said virus-like particle of an RNA bacteriophage consists essentially of recombinant proteins, or fragments thereof, of an RNA bacteriophage.

230. (new) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises recombinant coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:159;

(b) SEQ ID NO:160;

(c) SEQ ID NO:161;

(d) SEQ ID NO:162;

(e) SEQ ID NO:163;

(f) SEQ ID NO:164;

(g) SEQ ID NO:165;

(h) SEQ ID NO:166;

(i) SEQ ID NO:167;

(j) SEQ ID NO:215;

(k) SEQ ID NO:253;

(l) SEQ ID NO:217; and

(m) SEQ ID NO:254.

231. (new) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage consists essentially of recombinant coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:159;

(b) SEQ ID NO:160;

(c) SEQ ID NO:161;

(d) SEQ ID NO:162;

(e) SEQ ID NO:163;

(f) SEQ ID NO:164;

(g) SEQ ID NO:165;

(h) SEQ ID NO:166;

(i) SEQ ID NO:167;

(j) SEQ ID NO:215;

(k) SEQ ID NO:253;

(l) SEQ ID NO:217; and

(m) SEQ ID NO:254.

232. (new) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises recombinant coat proteins having an amino acid sequence of SEQ ID NO:159, or a mixture of coat proteins having amino acid sequences of SEQ ID NO:159 and of SEQ ID NO:217.

233. (new) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage consists essentially of coat proteins having an amino acid sequence of SEQ ID NO:159, or consists essentially of a mixture of coat proteins having amino acid sequences of SEQ ID NO:217 and of SEQ ID NO:159.

234. (new) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins of said RNA bacteriophage that have been modified by deletion or substitution to remove at least one naturally occurring lysine residue, or that have been modified by insertion or substitution to add at least one lysine residue.

235. (new) The composition of claim 234, wherein said RNA bacteriophage is Qβ.

236. (new) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins comprising an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:255;

(b) SEQ ID NO:256;

(c) SEQ ID NO:257;

(d) SEQ ID NO:258;

(e) SEQ ID NO:259; and

(f) a mixture of any one of (a)-(e) and the corresponding A1 protein.

237. (new) The composition of claim 220, wherein said virus-like particle of an RNA bacteriophage comprises one or more coat proteins consisting essentially of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:255;

(b) SEQ ID NO:256;

(c) SEQ ID NO:257;

(d) SEQ ID NO:258;

(e) SEQ ID NO:259; and

(f) a mixture of any one of (a)-(e) and the corresponding A1 protein.

238. (new) The composition of claim 220, wherein said organizer is an integral part of said RNA bacteriophage.

239. (new) The composition of claim 220, wherin said organizer is a polypeptide or residue thereof and said second attachment site is a polypeptide or residue thereof.

240. (new) The composition of claim 220, wherein said association is by way of at least one covalent bond.

241. (new) The composition of claim 220, further comprising an amino acid linker.

242. (new) The composition of claim 241, wherein said amino acid linker is bound to said antigen or said antigenic determinant by way of at least one covalent bond.

243. (new) The composition of claim 242, wherein said covalent bond is a peptide bond.

244. (new) The composition of claim 241, wherein said amino acid linker comprises said second attachment site.

245. (new) The composition of claim 241, wherein said amino acid linker is selected from the group consisting of:

(a) CGG;

(b) an N-terminal gamma 1-linker;

(c) an N-terminal gamma 3-linker;

(d) an Ig hinge region;

(e) an N-terminal glycine linker;

(f) $(G)_kC(G)_n$ with n=0-12 and k=0-5;

(g) an N-terminal glycine-serine linker;

(h) $(G)_kC(G)_m(S)_l(GGGGS)_n$ with n=0-3, k=0-5, m=0-10, l=0-2 (SEQ ID NO: 424);

(i) GGC;

(k) GGC-NH2;

(l) a C-terminal gamma 1-linker;

(m) a C-terminal gamma 3-linker;

(n) a C-terminal glycine linker;

(o) $(G)_nC(G)_k$ with n=0-12 and k=0-5;

(p) a C-terminal glycine-serine linker; and

(q) $(G)_m(S)_l(GGGGS)_n(G)_oC(G)_k$ with n=0-3, k=0-5, m=0-10, l=0-2, and o=0-8 (SEQ ID NO: 425).

246. (new) The composition of claim 241, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

247. (new) The composition of claim 220, wherein said first and said second attachment sites comprise an interacting pair selected from the group consisting of:

(a) an antigen and an antibody or antibody fragment thereto;

(b) biotin and avidin;

(c) streptavidin and biotin;

(d) a receptor and its ligand;

(e) a ligand-binding protein and its ligand;

(f) interacting leucine zipper polypeptides;

(g) an amino group and a chemical group reactive thereto;

(h) a carboxyl group and a chemical group reactive thereto; and

(i) a combination thereof of any of (a)-(h).

248. (new) The composition of claim 220, wherein said first attachment site and said second attachment site are associated through a heterobifunctional linker.

249. (new) The composition of claim 248, wherein said heterobifunctional linker is selected from the group consisting of:

(a) a maleimidocaproic acid N-hydroxysuccinimide ester;

(b) N-Succinimidyl 3-(2-pyridyldithio) propionate (SPDP); and

(c) Sulfo-MBS.

250. (new) The composition of claim 220, wherein said first attachment site comprises an amino group and said second attachment site comprises a sulfhydryl group.

251. (new) The composition of claim 220, wherein said first attachment site is an amino group and said second attachment site is a sulfhydryl group.

252. (new) The composition of claim 220, wherein said first attachment site is a lysine residue and said second attachment site is a cysteine residue.

253. (new) The composition of claim 220, wherein said first attachment site comprises a lysine residue.

254. (new) The composition of claim 220, wherein said first attachment site is a lysine residue.

255. (new) The composition of claim 220, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

256. (new) The composition of claim 220, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

257. (new) The composition of claim 220, wherein said second attachment site is a sulfhydryl group or is a cysteine residue.

258. (new) The composition of claim 220, wherein said self antigen is selected from the group consisting of:

(a) a lymphotoxin;

(b) a lymphotoxin receptor;

(c) RANKL;

(d) VEGF;

(e) VEGFR;

(f) Interleukin-5;

(g) Interleukin-17;

(h) Interleukin-13;

(i) Angiotensin;

(k) CCL21;

(l) CXCL12;

(m) SDF-1;

(n) MCP-1;

(o) Endoglin;

(p) Resistin;

(q) GHRH;

(r) LHRH;

(s) TRH;

(t) MIF;

(u) Eotaxin;

(v) Bradykinin;

(w) BLC;

(x) Tumor Necrosis Factor-α (TNF-α);

(y) a human IgE; and

(z) peptides or fragments of any of (a) through (y).

259. (new) The composition of claim 220, wherein said self antigen is angiotensin.

260. (new) The composition of claim 259, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

261. (new) The composition of claim 259, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

262. (new) The composition of claim 259, wherein said composition further comprises an amino acid linker.

263. (new) The composition of 262, wherein said amino acid linker comprises said second attachment site.

264. (new) The composition of claim 262, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

265. (new) The composition of claim 259, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) CGGDRVYIHPF (SEQ ID NO: 380);

(b) CGGDRVYIHPFHL (SEQ ID NO. 381)

(c) DRVYIHPFHLGGC (SEQ ID NO: 382); and

(d) CDRVYIHPFHL (SEQ ID NO: 383).

266. (new) The composition of claim 259, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) CGGDRVYIHPF (SEQ ID NO: 380);

(b) CGGDRVYIHPFHL (SEQ ID NO. 381)

(c) DRVYIHPFHLGGC (SEQ ID NO: 382); and

(d) CDRVYIHPFHL (SEQ ID NO: 383).

267. (new) The composition of claim 259, wherein said self antigen with said second attachment site consists of the amino acid sequence CGGDRVYIHPF (SEQ ID NO: 380).

268. (new) The composition of claim 220, wherein said self antigen is VEGFR-II.

269. (new) The composition of claim 268, wherein said self antigen is human VEGFR-II.

270. (new) The composition of claim 268, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

271. (new) The composition of claim 268, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

272. (new) The composition of claim 268, wherein said composition further comprises an amino acid linker.

273. (new) The composition of claim 272, wherein said amino acid linker comprises said second attachment site.

274. (new) The composition of claim 272, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

275. (new) The composition of claim 268, wherein said self antigen with said second attachment site comprises the amino acid sequence CTARTELNVGIDFNWEYPSSKHQHKK (SEQ ID NO:351).

276. (new) The composition of claim 268, wherein said self antigen with said second attachment site consists of the amino acid sequence CTARTELNVGIDFNWEYPSSKHQHKK (SEQ ID NO:351).

277. (new) The composition of claim 220, wherein said self antigen is tumor necrosis factor-α (TNF-α).

278. (new) The composition of claim 277, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

279. (new) The composition of claim 277, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

280. (new) The composition of claim 277, wherein said composition further comprises an amino acid linker.

281. (new) The composition of 280, wherein said amino acid linker comprises said second attachment site.

282. (new) The composition of claim 280, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

283. (new) The composition of claim 277, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) CSSRTPSDKPVAHVVANPQAEGQ (SEQ ID NO:398);

(b) SSRTPSDKPVAHVVANPQAEGQGGC (SEQ ID NO:399);

and

(c) CGGQLQWLNRRANA (SEQ ID NO:400).

284. (new) The composition of claim 277, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) CSSRTPSDKPVAHVVANPQAEGQ (SEQ ID NO:398);

(b) SSRTPSDKPVAHVVANPQAEGQGGC (SEQ ID NO:399);

and

(c) CGGQLQWLNRRANA (SEQ ID NO:400).

285. (new) The composition of claim 220, wherein said self antigen is resistin.

286. (new) The composition of claim 285, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

287. (new) The composition of claim 285, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

288. (new) The composition of claim 285, wherein said composition further comprises an amino acid linker.

289. (new) The composition of 288, wherein said amino acid linker comprises said second attachment site.

290. (new) The composition of claim 288, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

291. (new) The composition of claim 285, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:325

(b) SEQ ID NO:326; and

(c) SEQ ID NO:327.

292. (new) The composition of claim 285, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:325

(b) SEQ ID NO:326; and

(c) SEQ ID NO:327.

293. (new) The composition of claim 220, wherein said self antigen is a lymphotoxin.

294. (new) The composition of claim 293, wherein said lymphotoxin is selected from the group consisiting of:

(a) lymphotoxin α (LTα);

(b) lymphotoxin β (LTβ); and

(c) a mixture or combination of LTα and LTβ.

295. (new) The composition of claim 293, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

296. (new) The composition of claim 293, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

297. (new) The composition of claim 293, wherein said composition further comprises an amino acid linker.

298. (new) The composition of 297, wherein said amino acid linker comprises said second attachment site.

299. (new) The composition of claim 297, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

300. (new) The composition of claim 293, wherein said lymphotoxin is lymphotoxin β and wherein said lymphotoxin β with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:346; and

(b) SEQ ID NO:347.

301. (new) The composition of claim 293, wherein said lymphotoxin is lymphotoxin β and wherein said lymphotoxin β with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:346; and

(b) SEQ ID NO:347.

302. (new) The composition of claim 220, wherein said self antigen is MIF.

303. (new) The composition of claim 302 wherein self antigen is human-MIF.

304. (new) The composition of claim 302, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

305. (new) The composition of claim 302, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

306. (new) The composition of claim 302, wherein said composition further comprises an amino acid linker.

307. (new) The composition of claim 306, wherein said amino acid linker comprises said second attachment site.

308. (new) The composition of claim 306, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

309. (new) The composition of claim 302, wherein said self antigen with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:310;

(b) SEQ ID NO:311;

(c) SEQ ID NO:312;

(d) SEQ ID NO:313;

(e) SEQ ID NO:314; and

(f) SEQ ID NO:315.

310. (new) The composition of claim 302, wherein said self antigen with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:310;

(b) SEQ ID NO:311;

(c) SEQ ID NO:312;

(d) SEQ ID NO:313;

(e) SEQ ID NO:314; and

(f) SEQ ID NO:315.

311. (new) The composition of claim 220, wherein said self antigen is RANKL.

312. (new) The composition of claim 311, wherein said self antigen is human-RANKL.

313. (new) The composition of claim 311, wherein said self antigen is an extracellular domain of RANKL.

314. (new) The composition of claim 311, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

315. (new) The composition of claim 311, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

316. (new) The composition of claim 311, wherein said composition further comprises an amino acid linker.

317. (new) The composition of 316, wherein said amino acid linker comprises said second attachment site.

318. (new) The composition of claim 316, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

319. (new) The composition of claim 311, wherein said self antigen with said second attachment site comprises the amino acid sequence of SEQ ID NO:320.

320. (new) The composition of claim 311, wherein said self antigen with said second attachment site consists of the amino acid sequence of SEQ ID NO:320.

321. (new) The composition of claim 220, wherein said self antigen is phospholipase A_2.

322. (new) The composition of claim 321, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

323. (new) The composition of claim 321, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

324. (new) The composition of claim 321, wherein said composition further comprises an amino acid linker.

325. (new) The composition of claim 324, wherein said amino acid linker comprises said second attachment site.

326. (new) The composition of claim 324, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

327. (new) The composition of claim 321, wherein said phospholipase A_2 protein with said second attachment site comprises an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:168;

(b) SEQ ID NO:169;

(c) SEQ ID NO:170;

(d) SEQ ID NO:171;

(e) SEQ ID NO:172;

(f) SEQ ID NO:173;

(g) SEQ ID NO:174; and

(h) SEQ ID NO:175.

328. (new) The composition of claim 321, wherein said phospholipase A_2 protein with said second attachment site consists of an amino acid sequence selected from the group consisting of:

(a) SEQ ID NO:168;

(b) SEQ ID NO:169;

(c) SEQ ID NO:170;

(d) SEQ ID NO:171;

(e) SEQ ID NO:172;

(f) SEQ ID NO:173;

(g) SEQ ID NO:174; and

(h) SEQ ID NO:175.

329. (new) The composition of claim 220, wherein said self antigen is IgE.

330. (new) The composition of claim 329, wherein said second attachment site does not naturally occur within said antigen or antigenic determinant.

331. (new) The composition of claim 329, wherein said second attachment site comprises a sulfhydryl group or a cysteine residue.

332. (new) The composition of claim 329, wherein said composition further comprises an amino acid linker.

333. (new) The composition of claim 332, wherein said amino acid linker comprises said second attachment site.

334. (new) The composition of claim 332, wherein said amino acid linker comprises a sulfhydryl group or a cysteine residue.

335. (new) The composition of claim 329, wherein said IgE with said second attachment site comprises the amino acid sequence of SEQ ID NO:176.

336. (new) The composition of claim 329, wherein said IgE with said second attachment site consists of the amino acid sequence of SEQ ID NO:176.

337. (new) The composition of claim 220, wherein said self antigen is a lymphotoxin receptor.

338. (new) The composition of claim 220, wherein said self antigen is VEGF.

339. (new) The composition of claim 220, wherein said self antigen is Interleukin-5.

340. (new) The composition of claim 220, wherein said self antigen is Interleukin-17.

341. (new) The composition of claim 220, wherein said self antigen is Interleukin-13.

342. (new) The composition of claim 220, wherein said self antigen is CCL21.

343. (new) The composition of claim 220, wherein said self antigen is CXCL12.

344. (new) The composition of claim 220, wherein said self antigen is SDF-1.

345. (new) The composition of claim 220, wherein said self antigen is MCP-1.

346. (new) The composition of claim 220, wherein said self antigen is Endoglin.

347. (new) The composition of claim 220, wherein said self antigen is GHRH.

348. (new) The composition of claim 220, wherein said self antigen is LHRH.

349. (new) The composition of claim 220, wherein said self antigen is TRH.

350. (new) The composition of claim 220, wherein said self antigen is Eotaxin.

351. (new) The composition of claim 220, wherein said self antigen is Bradykinin.

352. (new) The composition of claim 220, wherein said self antigen is BLC.

353. (new) The composition of claim 220, wherein said self antigen is suitable to induce an immune response against cancer cells.

354. (new) The composition of claim 353, wherein said self antigen is:

(a) a protein of breast cancer cells;

(b) a protein of kidney cancer cells;

(c) a protein of prostate cancer cells;

(d) a protein of skin cancer cells;

(e) a protein of brain cancer cells; or

(f) a protein of leukemia cells.

355. (new) A pharmaceutical composition comprising:

(a) the composition of claim 220; and

(b) an acceptable pharmaceutical carrier.

356. (new) A method of immunization comprising administering the composition of claim 220 to a subject.

357. (new) An immunogenic composition comprising the composition of claim 220 and an adjuvant.

358. (new) A method of immunization comprising administering the composition of claim 357 to a subject.

359. (new) A process for producing a non-naturally occurring, ordered and repetitive antigen array comprising:

(a) providing a non-natural molecular scaffold comprising:

(i) a core particle comprising a virus-like particle of an RNA bacteriophage; and

(ii) an organizer comprising at least one first attachment site, wherein said organizer is connected to said core particle by at least one covalent bond;

(b) providing an antigen or antigenic determinant with at least one second attachment site,

wherein said antigen or antigenic determinant is at least one self antigen, a peptide thereof, or a fragment thereof;

wherein said second attachment site is capable of association through at least one non-peptide bond to said first attachment site; and

(c) combining said non-natural molecular scaffold and said antigen to form an ordered and repetitive antigen array.

360. (new) The process of claim 359, wherein said organizer is a polypeptide or residue thereof; and wherein said second attachment site is a polypeptide or residue thereof.

361. (new) The process of claim 359, wherein said association is by way of at least one covalent bond.